THE CMEE LIBRARY FOR SIMULATING ELECTRON EFFECTS

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Abstract

Unwanted electrons in an ion accelerator can result from ion-wall interaction and from ionization of background and desorbed gas. These electrons are suspected of limiting the performance of many of today's ion accelerators. One way to investigate the effects of contaminant electrons is with computer modeling, but this requires accurate numerical models of the electron generation mechanisms. The CMEE library provides numerical routines for electron effects and makes them callable from both Fortran and C and portable to Linux, Windows, and Mac OS X.

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Unwanted electrons are suspected of limiting the performance of many of today's ion accelerators. Two sources of these electrons are those resulting from ion-wall interaction and those resulting from ionization of background or desorbed gas. One way to investigate the effects of contaminant electrons is with computer modeling, but this requires accurate numerical models of the electron generation mechanisms. The CMEE library [1] provides numerical routines for modeling such electron effects. Where possible, the routines are based on well-known and well-tested routines from the community. Also, the routines compile on Windows, Mac OS X, Linux and Unix, and binding to the routines are available in Fortran and C. CMEE is freely available for non-commercial use.

The CMEE library currently contains a routine from the POSINST code [2] for calculating secondary electron emission from copper. This routine takes as input the energy and angle of an incident electron and returns the number and velocity components of secondary electrons produced. Figure 1 shows simulation results for the secondary yield as a function of energy for electrons striking copper at normal incidence. We generated these results using the POSINST routine included in the CMEE library.

Two issues we addressed in adding the POSINST secondary electron routine to CMEE were common blocks and commercial library calls. To make the secondary routine portable to other codes, we had to eliminate data shared through common blocks and instead pass that data as arguments. Also, the original routine in POSINST used a commercial math library not freely available to other users. We had to replace these routines with free routines.

Because researchers use a variety of computer platforms, the CMEE routines are most useful if they compile automatically on all the popular platforms. The CMEE project uses the GNU autotools [3] to create makefiles automatically for the various platforms. Autotools also provides cross language support by providing preprocessor macros that contain the Fortran name of a given C subroutine, meaning that users can call the routines from either Fortran or C.

CMEE will soon contain electron and proton impact ionization routines and ion-material energy loss routines. Additional future work may include developing electron yield models for titanium nitride, electron yield models for photon-induced desorption, heavy-ion impact ionization cross-section models, ion-surface scattering models, and models of ion-induced neutral gas desorption.

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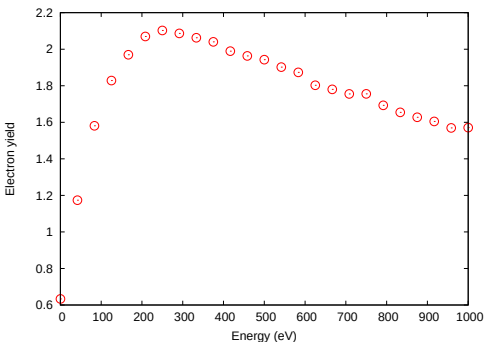

Figure 1: Simulation results for the secondary yield as a function of energy for electrons striking copper at normal incidence. We generated these results using the Monte-Carlo technique with a POSINST routine included in the CMEE library.

REFERENCES

[1] http://www.txcorp.com/technologies/CMEE/index.php

[2] M. A. Furman and M. Pivi, Phys. Rev. ST Accel. Beams, **5** (2002) 124404.

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